

REPORT NUMBER: 201-VER-04-04

**SAFETY COMPLIANCE TESTING FOR FMVSS 201
OCCUPANT PROTECTION IN INTERIOR IMPACT**

**AUTO ALLIANCE INTERNATIONAL INC. FOR MAZDA MOTOR CORPORATION
2004 MAZDA 6 4-DOOR SEDAN**

NHTSA NUMBER: C45400

GD TEST NUMBER: 8655-F201-27

ADVANCED INFORMATION ENGINEERING SERVICES
A GENERAL DYNAMICS COMPANY
TRANSPORTATION SCIENCES CENTER
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Test Date: July 20, 2004

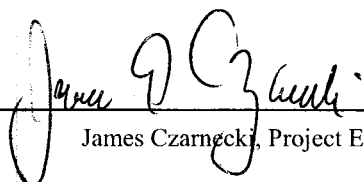
FINAL REPORT

PREPARED FOR:

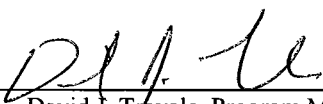
U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
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Office of Vehicle Safety Compliance
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Washington, DC 20590

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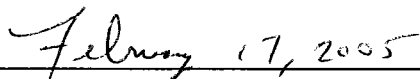
Prepared by:


James Czarniecki, Project Engineer

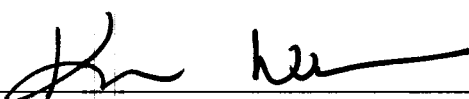
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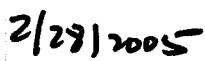

David J. Travale, Program Manager
Transportation Science Center

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16. Abstract Compliance tests were conducted on the subject vehicle, a 2004 Mazda 6, 4-door Sedan, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure TP-201-02 for determination of FMVSS 201 compliance. Test failures identified were as follows: Interior compartment door, located in the center of the instrument panel of the vehicle tested, did not remain closed, as required by S5.3 of FMVSS 201, when the instrument panel was tested in accordance with S5.1.			
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SECTION 1

PURPOSE AND TEST PROCEDURE

This head impact compliance test is part of the FMVSS 201, Occupant Protection in Interior Impact, Test Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-01-C-01025. The purpose of this compliance test was to determine whether the subject vehicle, a 2004 Mazda 6, 4-door Sedan, NHTSA No. C45400, meets the performance requirements of FMVSS 201, Occupant Protection in Interior Impact. The compliance test was conducted using the requirements found in the OVSC Laboratory Test Procedure No. TP-201-02 dated March 3, 1989.

SECTION 2

SUMMARY OF OCCUPANT PROTECTION IN INTERIOR IMPACTS

A 2004 Mazda 6, 4-door Sedan, NHTSA No. C45400, was impacted at various locations throughout its instrument cluster/dash panel and seat back area by a 15 lb, 6.5 inch diameter steel headform. A total of four (4) impacts were performed in this test series. The four (4) chosen impact points were:

Seat Back / Head Restraint

Instrument Panel (3 impacts)

The selected impact areas on the test vehicle appeared to comply with the performance requirements of FMVSS 201 with the exception of the interior compartment door, located in the center of the instrument panel of the vehicle tested, that did not remain closed, as required by S5.3 of FMVSS 201, when the instrument panel was tested in accordance with S5.1.

The 6.5 inch diameter steel headform weighed 15 lb and had an accelerometer mounted along its centerline.

One (1) channel of data for each target impact test was recorded on a Keyser-Threde data acquisition system. Data plots can be found in Appendix C. Still photographs can be found in Appendix A of this report.

TEST VEHICLE RECEIVING INSPECTION DATA SHEET

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Mazda 6 4-door Sedan
NHTSA NO.:	C45400
VIN:	IYVFP80C345N22817
DATE OF MANUFACTURE:	09/03 (SEE CERTIFICATION LABEL)
COLOR:	Silver
ODOMETER READING:	24 miles
LABORATORY:	GD Engineering
TEST DATE:	July 20, 2004

NUMBER OF SEATING POSITIONS:

FRONT: 2 REAR: 3

INSTRUMENT PANEL:

NOTE UNUSUAL FEATURES: None

TYPE OF FRONT SEATS:

BENCH: - BUCKET: X SPLIT BACKS: -

TYPE OF HEAD RESTRAINTS:

FIXED: - ADJUSTABLE: X

VEHICLE EQUIPPED WITH ARMRESTS?

NO: - YES: X NUMBER: 3

LOCATION: Front and rear door panels and center console arm rest

VEHICLE EQUIPPED WITH SUN VISORS?

NO: - YES: X

VEHICLE EQUIPPED WITH INTERIOR DOOR LATCHES?

NO: - YES: X NUMBER: 4

LOCATION: Glove Box, Coin Box, Instrument Panel Storage Compartment and Center Console Armrest

HEADFORM IMPACT TEST RESULTS **INSTRUMENT PANEL**

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Mazda 6 4-door Sedan
NHTSA NO.:	C45400
VIN:	IYVFP80C345N22817
DATE OF MANUFACTURE:	09/03 (SEE CERTIFICATION LABEL)
COLOR:	Silver
ODOMETER READING:	24 miles
LABORATORY:	GD Engineering
TEST DATE:	July 20, 2004

IMPACT LOCATION AND NUMBER				VELOCITY (mph)	PEAK ACCELERATION (3 ms Clip) Gs
NUMBER	X (inches)	Y (inches)	ANGLE (degrees)		
1 Instrument Panel Center	25.4	-0.5	-38	11.4	61.54
2 Left Side of Airbag Cover	27.0	8.5	-45	11.5	64.81
3 Right Side of Airbag Cover	27.4	19.6	-51	11.4	62.78

REFERENCE POINT: +x forward Front Passenger Seating Reference Point
+y to the right of the Vehicle Centerline

REMARKS:

Interior compartment door, located in the center of the instrument panel of the vehicle tested, did not remain closed, as required by S5.3 of FMVSS 201, when the instrument panel was tested in accordance with S5.1.

HEADFORM IMPACT TEST RESULTS **SEAT BACKS**

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Mazda 6 4-door Sedan
NHTSA NO.:	C45400
VIN:	IYVFP80C345N22817
DATE OF MANUFACTURE:	09/03 (SEE CERTIFICATION LABEL)
COLOR:	Silver
ODOMETER READING:	24 miles
LABORATORY:	GD Engineering
TEST DATE:	June 7, 2004

IMPACT LOCATION AND NUMBER				VELOCITY (mph)	PEAK ACCELERATION (3 ms Clip) Gs
NUMBER	X (inches)	Y (inches)	ANGLE (degrees)		
Seat Back	9.2	0	40	14.5	36.65

REFERENCE POINT: +x forward Rear Passenger Seating Reference Point
+y to the right of the Seat Centerline

SUNVISOR AND ARMREST EVALUATION

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Mazda 6 4-door Sedan
NHTSA NO.:	C45400
VIN:	IYVFP80C345N22817
DATE OF MANUFACTURE:	09/03 (SEE CERTIFICATION LABEL)
COLOR:	Silver
ODOMETER READING:	24 miles
LABORATORY:	GD Engineering
TEST DATE:	July 20, 2004

SUN VISOR INFORMATION:

- Are sun visors constructed of or covered with energy absorbing material?

YES (PASS): X NO (FAIL): -

- Are any edges statically contactable by a spherical 6.5 inch diameter headform of radius less than 0.125 inch?

YES (FAIL): - NO (PASS): X

ARMREST INFORMATION:

A. FIXED ARMREST

- Is it constructed of energy absorbing material with the capability of laterally deflecting 2 inches without contacting any underlying rigid material?

YES: N/A NO: N/A

- Is it constructed of energy absorbing material that deflects or collapses within 1.25 inches of the rigid test panel surface without contacting underlying rigid material between 0.50 and 1.25 inches from the panel which has a vertical height of less than 1 inch?

YES: N/A NO: N/A

- Does it provide adequate pelvic area impact protection?

YES: X NO: -

- Does it meet at least one of the criteria No. 1 to 3?

YES (PASS): X NO (FAIL): -

B. FOLDING ARMREST

Is it made of or covered with energy absorbing material? Or does it meet at least one of the criteria No. 1 to 3?

YES (PASS): X NO (FAIL): -

DOOR LATCH EVALUATION

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Mazda 6 4-door Sedan
NHTSA NO.:	C45400
VIN:	IYVFP80C345N22817
DATE OF MANUFACTURE:	09/03 (SEE CERTIFICATION LABEL)
COLOR:	Silver
ODOMETER READING:	24 miles
LABORATORY:	GD Engineering
TEST DATE:	July 20, 2004

LATCH ENGAGEMENT INTERFERENCE (S5.3.1)

DESCRIPTION OF LATCH LOCATION	NO LOAD	10G HORIZONTAL TRANSVERSE	10G VERTICAL	30G HORIZONTAL LONGITUDINAL
Glove Box	Pass	Pass	Pass	Pass
Coin Box	Pass	Pass	Pass	Pass
Center Console Arm Rest	Pass	Pass	Pass	Pass

(APPENDIX B CONTAINS CALCULATION SHEETS WHICH ARE BASED ON MANUFACTURER'S DATA)

SUMMARY OF RESULTS

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Mazda 6 4-door Sedan
NHTSA NO.:	C45400
VIN:	IYVFP80C345N22817
DATE OF MANUFACTURE:	09/03 (SEE CERTIFICATION LABEL)
COLOR:	Silver
ODOMETER READING:	24 miles
LABORATORY:	GD Engineering
TEST DATE:	July 20, 2004

	NUMBER OF IMPACTS	PASS/FAIL
INSTRUMENT PANEL	3	Pass
SEAT BACK	1	Pass
SUN VISORS	n/a	Pass
ARMRESTS	n/a	Pass
INTERIOR COMPARTMENT DOORS		
Instrument Panel Storage Compartment	n/a	Fail*
Glove Box	n/a	Pass
Coin Box	n/a	Pass
Center Console Armrest	n/a	Pass

REMARKS:

n/a - not applicable

* Interior compartment door, located in the center of the instrument panel of the vehicle tested, did not remain closed, as required by S5.3 of FMVSS 201, when the instrument panel was tested in accordance with S5.1.

APPENDIX A

PHOTOGRAPHS

PHOTOGRAPHS

<u>FIGURE</u>	<u>VIEW</u>
A-1	LEFT SIDE VIEW OF VEHICLE
A-2	RIGHT SIDE VIEW OF VEHICLE
A-3	3/4 FRONTAL VIEW FROM LEFT SIDE OF VEHICLE
A-4	3/4 REAR VIEW FROM RIGHT SIDE OF VEHICLE
A-5	VEHICLE'S CERTIFICATION LABEL
A-6	VEHICLE'S TIRE INFORMATION LABEL
A-7	SUN VISOR CONSTRUCTION
A-8	ARMREST LEFT FRONT DOOR
A-9	ARMREST LEFT REAR DOOR
A-10	CONSOLE ARMREST
A-11	REAR SEAT CENTER ARMREST
A-12	INSTRUMENT PANEL
A-13	DELINEATED INSTRUMENT PANEL IMPACT ZONE PRE-TEST
A-14	INSTRUMENT PANEL LEFT SIDE AIRBAG COVER IMPACT PRE-TEST
A-15	INSTRUMENT PANEL LEFT SIDE AIRBAG COVER IMPACT POST-TEST
A-16	INSTRUMENT PANEL RIGHT SIDE AIRBAG COVER IMPACT PRE-TEST
A-17	INSTRUMENT PANEL RIGHT SIDE AIRBAG COVER IMPACT POST-TEST
A-18	INSTRUMENT PANEL IMPACT PRE-TEST
A-19	INSTRUMENT PANEL IMPACT POST-TEST
A-20	HEAD RESTRAINT
A-21	HEAD RESTRAINT IMPACT AREA PRE-TEST
A-22	HEAD RESTRAINT IMPACT AREA POST-TEST



Figure A-1 : LEFT SIDE VIEW OF VEHICLE

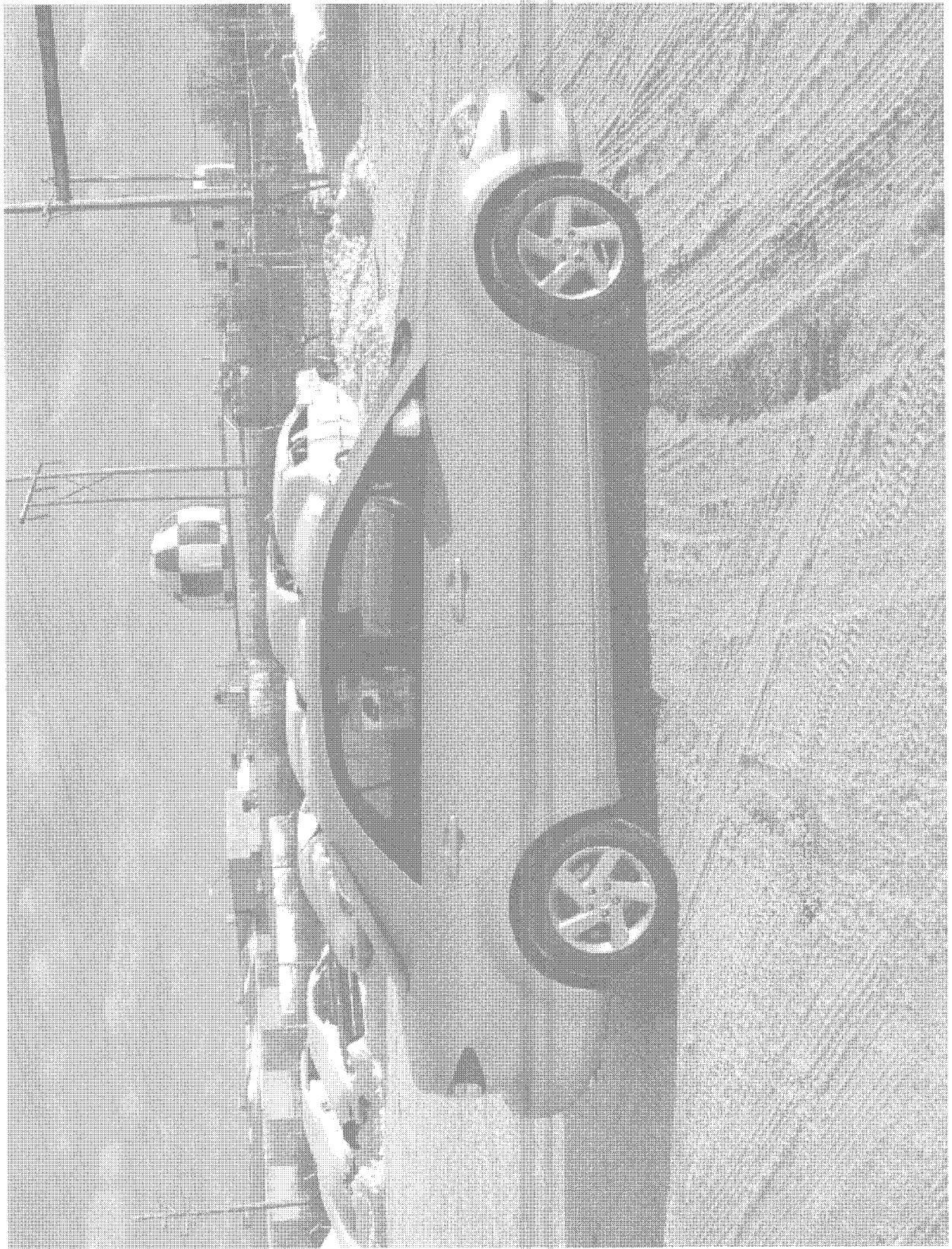


Figure A-2 : RIGHT SIDE VIEW OF VEHICLE



Figure A-3 : 3/4 FRONTAL VIEW FROM LEFT SIDE OF VEHICLE

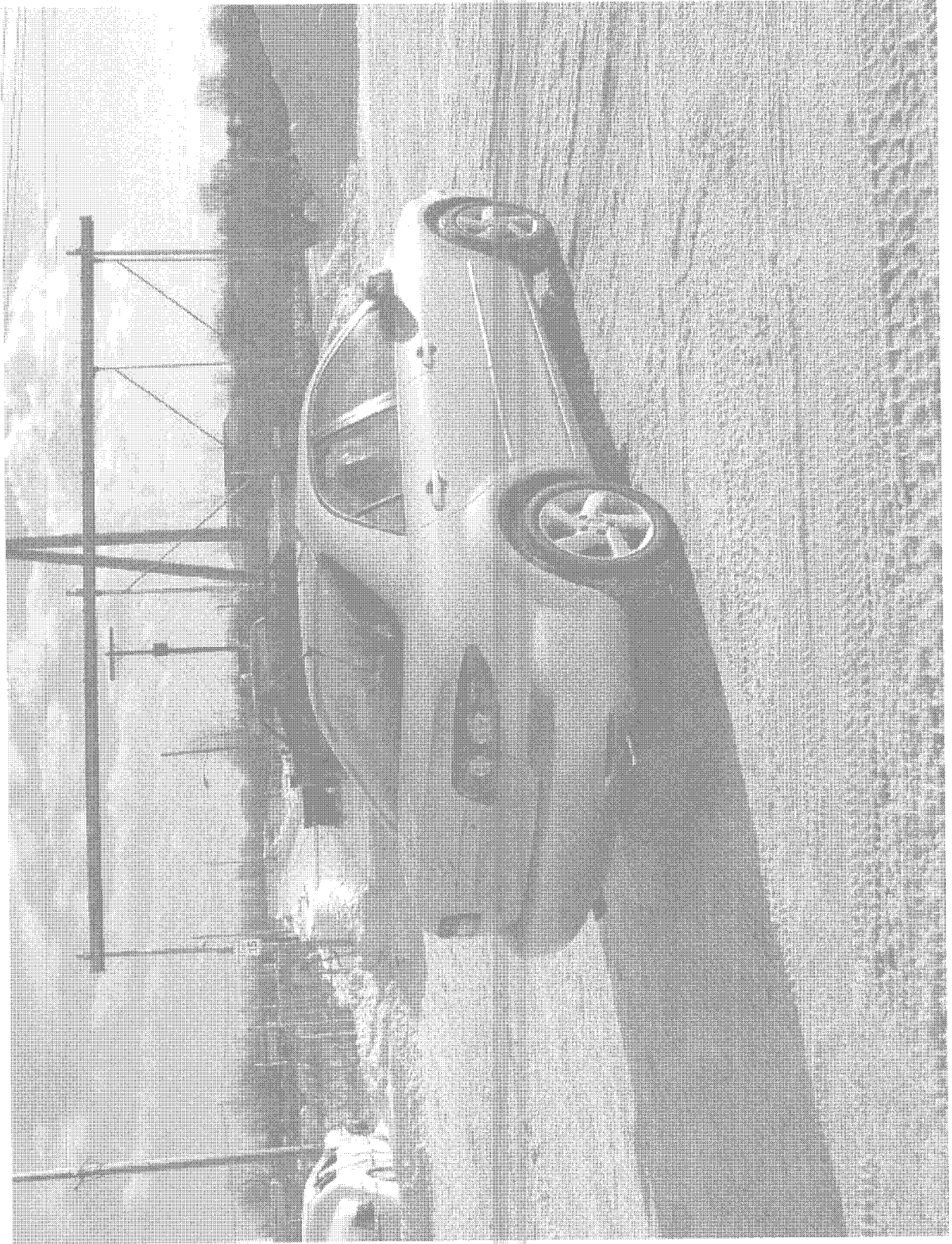


Figure A-4 : 3/4 REAR VIEW FROM RIGHT SIDE OF VEHICLE

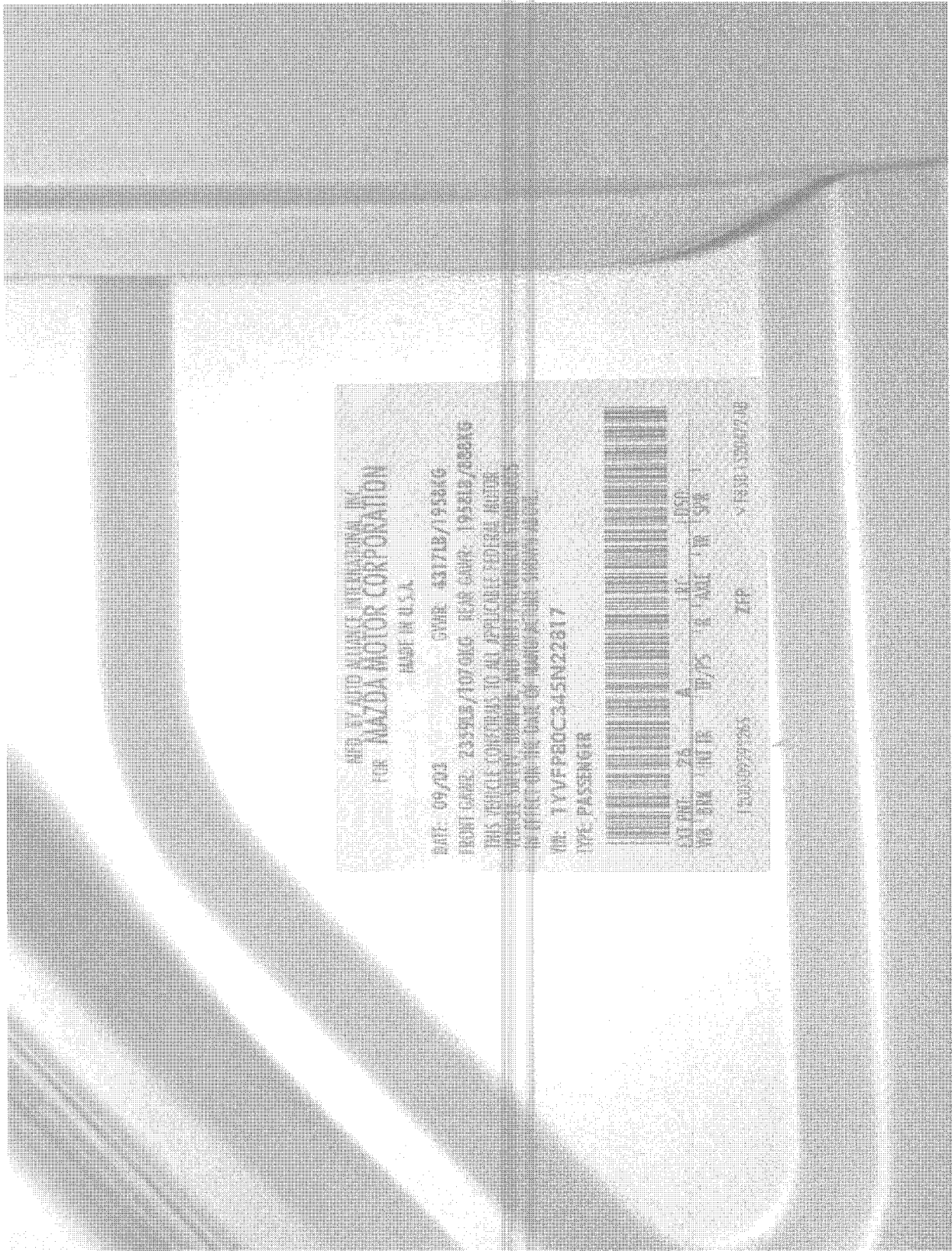


Figure A-5 : VEHICLE'S CERTIFICATION LABEL

VEHICLE CAPACITY WEIGHT (GK2A)
 CAPACITÉ PORTEUSE DU VEHICULE 385kg(850 lbs)
 FRONT SEAT
 SIÈGE AVANT 2
 REAR SEAT
 SIÈGE ARRIÈRE . . . 3
 SEATING CAPACITY
 NOMBRE DE PLACES TOTAL 5

TIRE INFLATION PRESSURE	FRONT/AV.	REAR/AR.
PRESSION DE GONFLAGE DES	220	220
PNEUS KPa(Kgf/cm ²)<p.s.i./lb/po ² >	(2.2)<32>	(2.2)<32>
TIRE SIZE	P205/60R16 91H	
TAILLE DES PNEUS	P215/50R17 93V	

Figure A-6 : VEHICLE'S TIRE INFORMATION LABEL

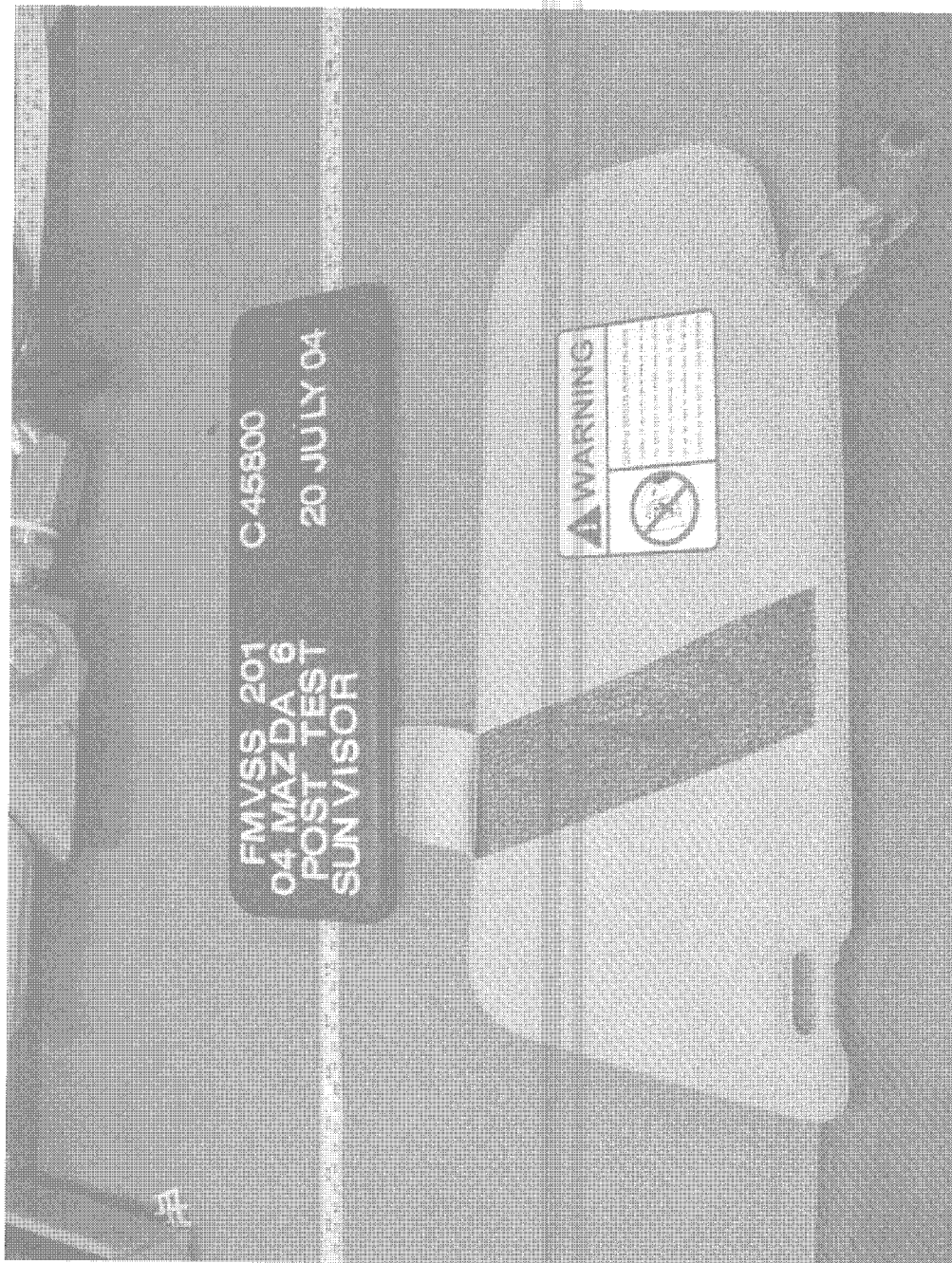


Figure A-7 : SUNVISOR CONSTRUCTION

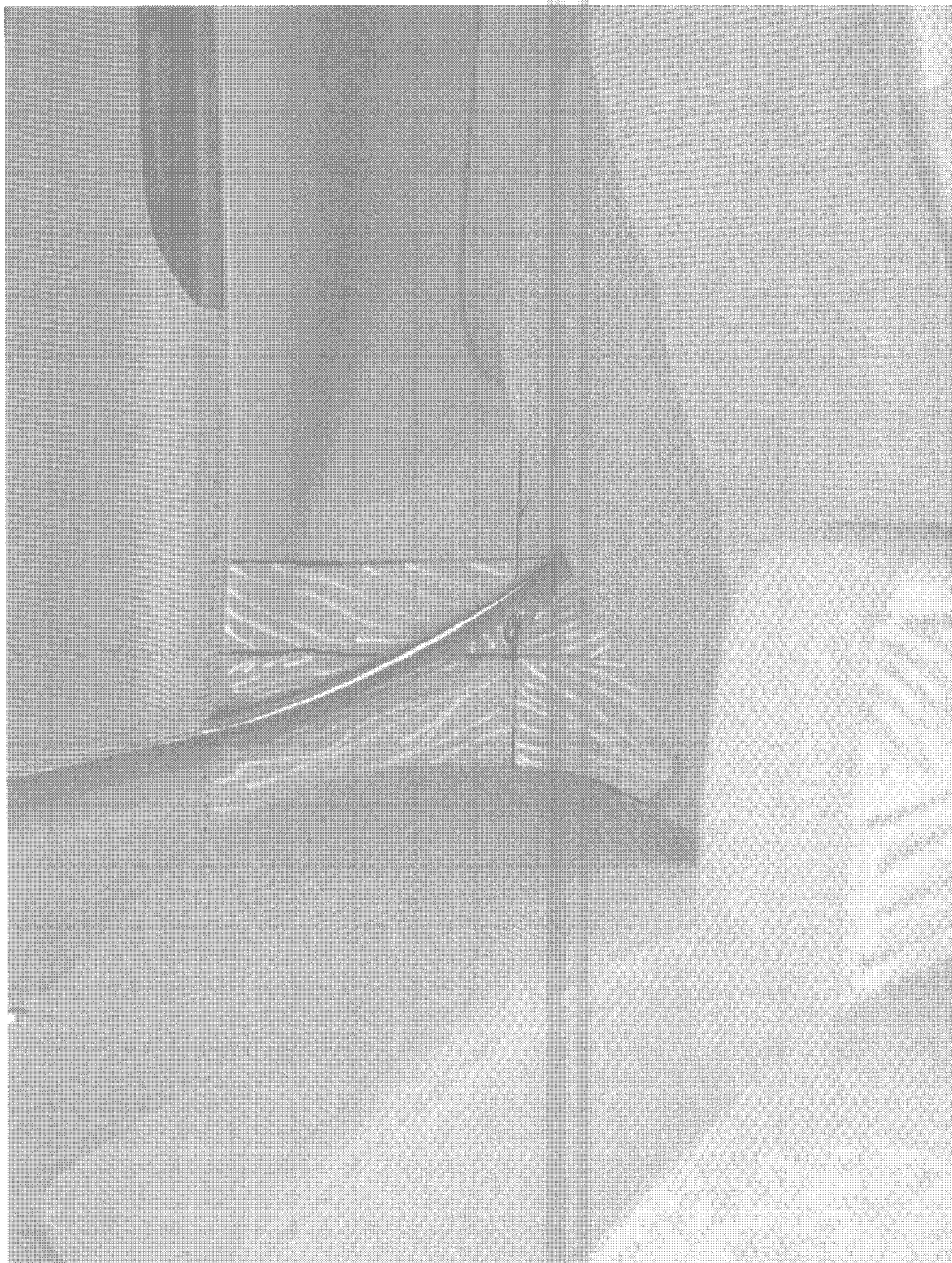


Figure A-8 : ARMREST LEFT FRONT DOOR

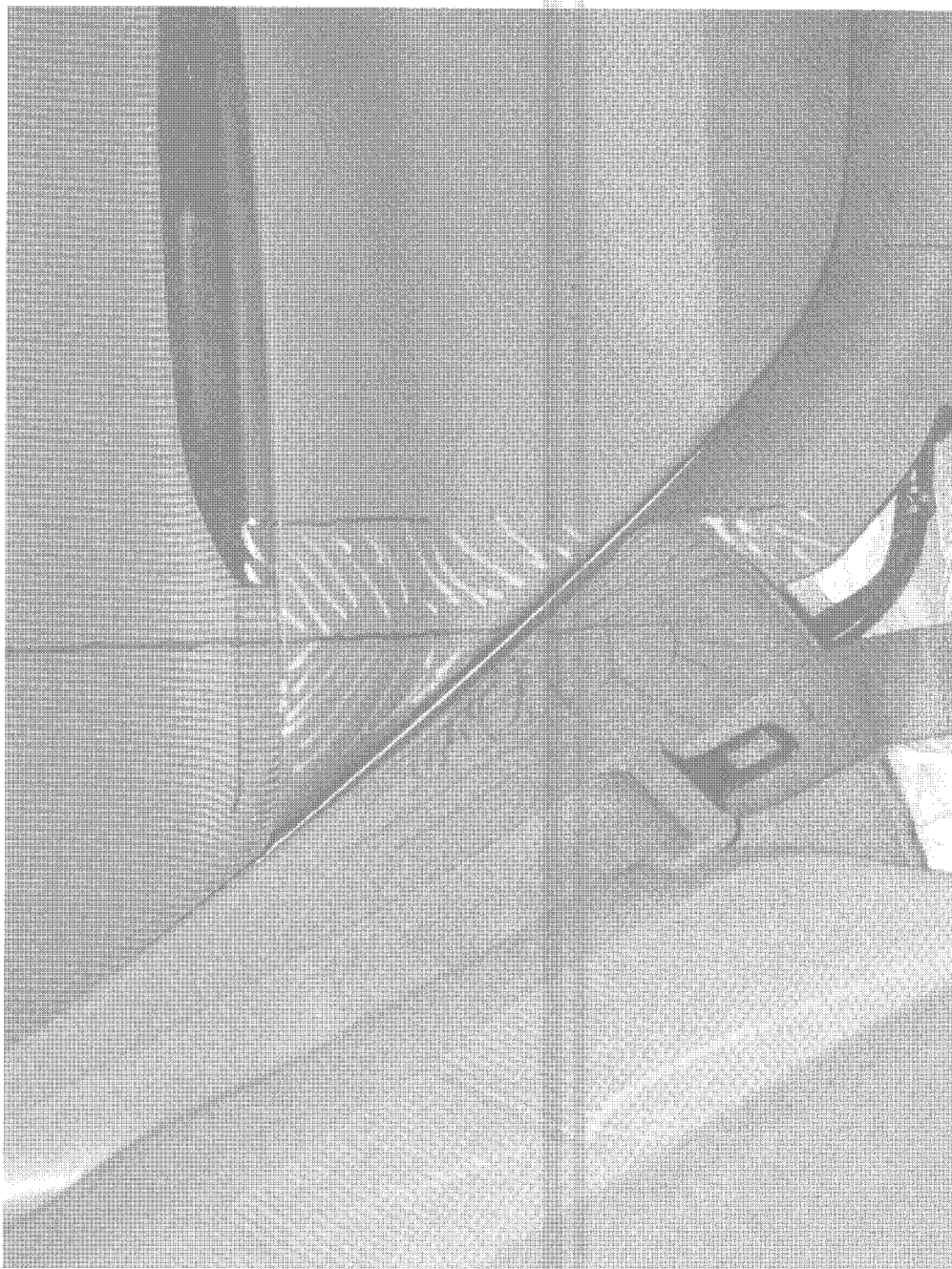


Figure A-9 : ARMREST LEFT REAR DOOR



Figure A-10 : CONSOLE ARMREST

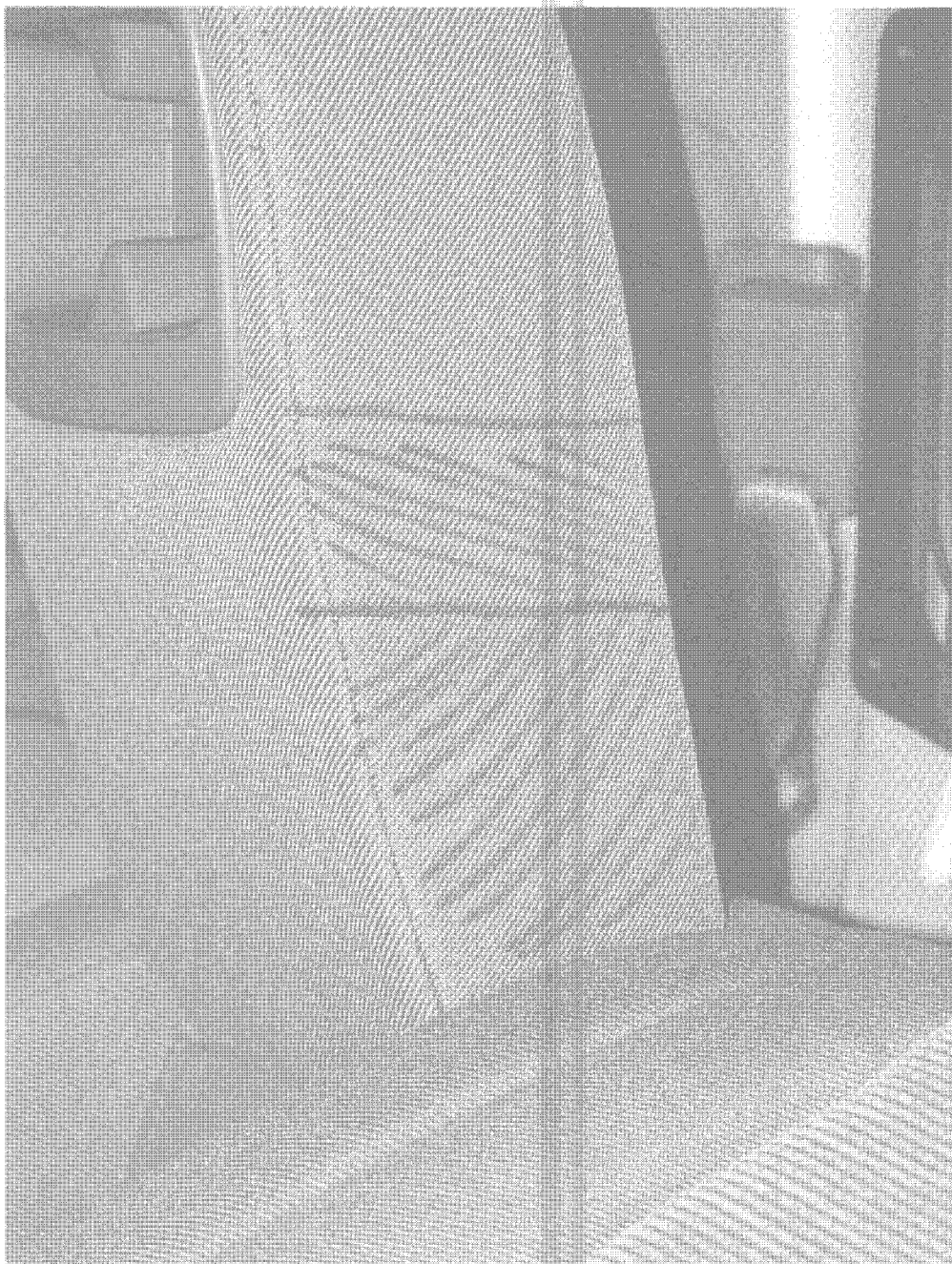


Figure A-11 : REAR SEAT CENTER ARMREST



Figure A-12 : INSTRUMENT PANEL

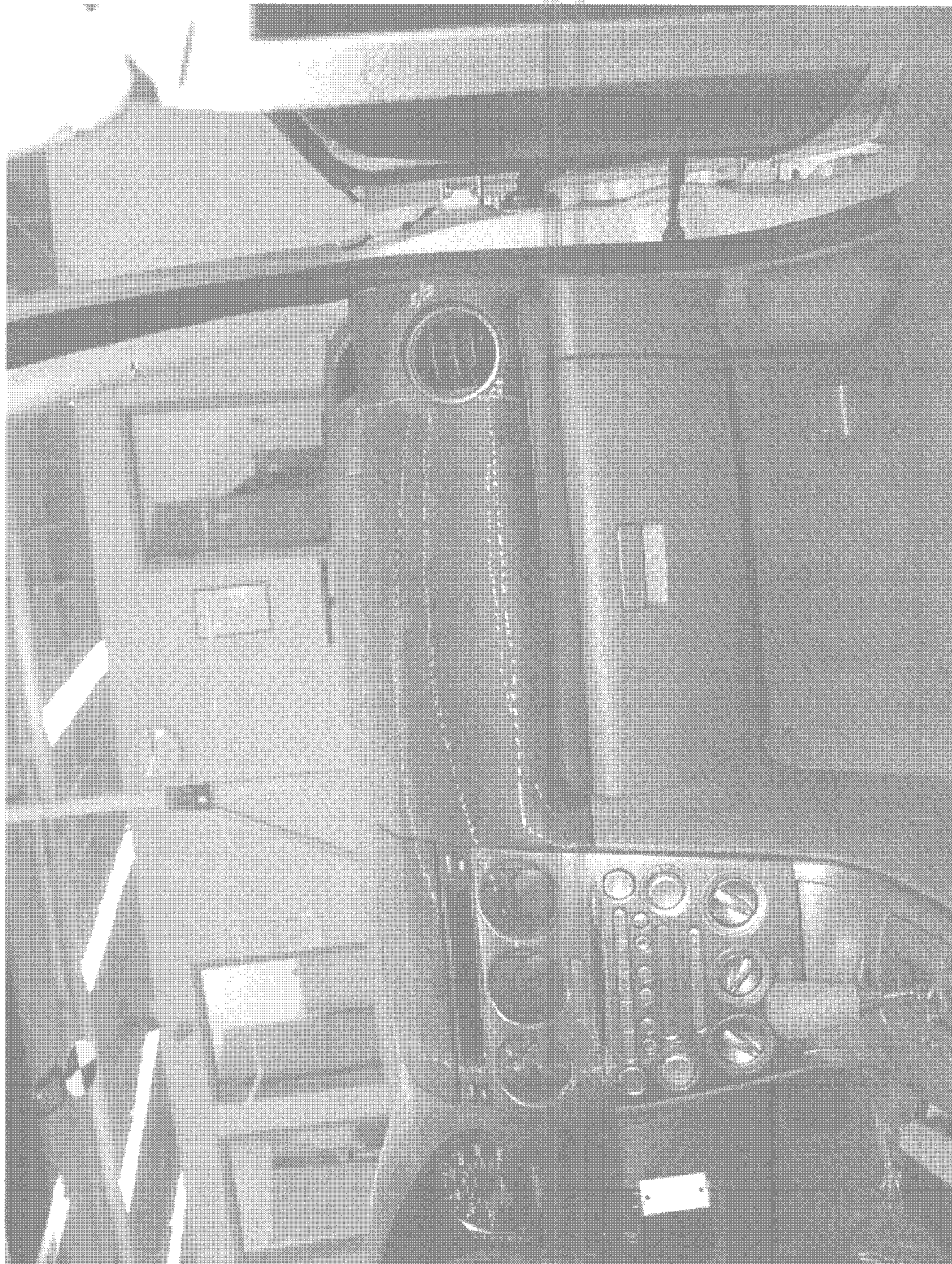


Figure A-13 : DELINEATED INSTRUMENT PANEL IMPACT ZONE PRE-TEST



Figure A-14 : INSTRUMENT PANEL LEFT SIDE AIRBAG COVER IMPACT PRE-TEST

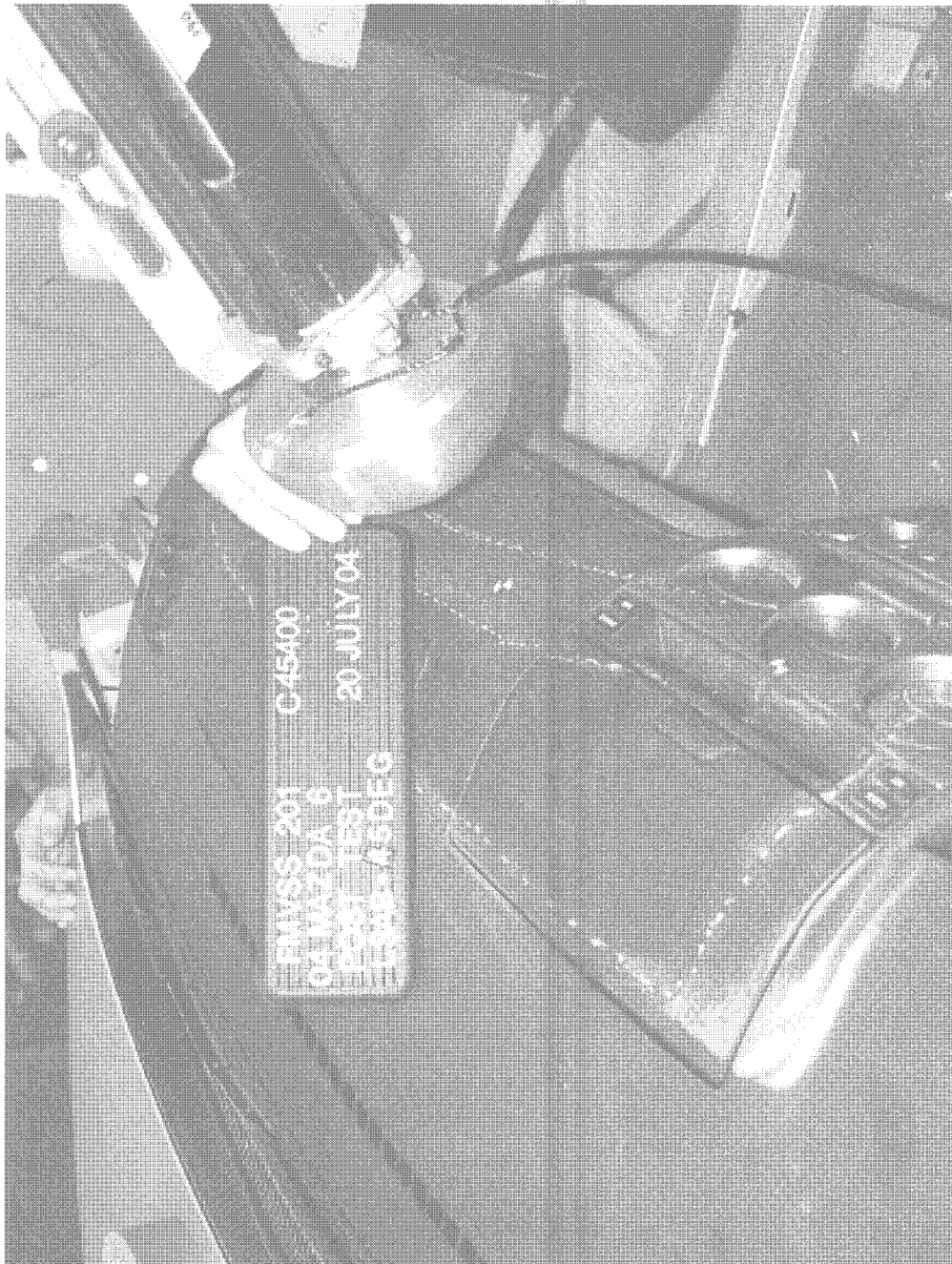


Figure A-15 : INSTRUMENT PANEL LEFT SIDE AIRBAG COVER IMPACT POST-TEST



Figure A-16 : INSTRUMENT PANEL RIGHT SIDE AIRBAG COVER IMPACT PRE-TEST



Figure A-17 : INSTRUMENT PANEL RIGHT SIDE AIRBAG COVER IMPACT POST-TEST



Figure A-18 : INSTRUMENT PANEL IMPACT PRE-TEST

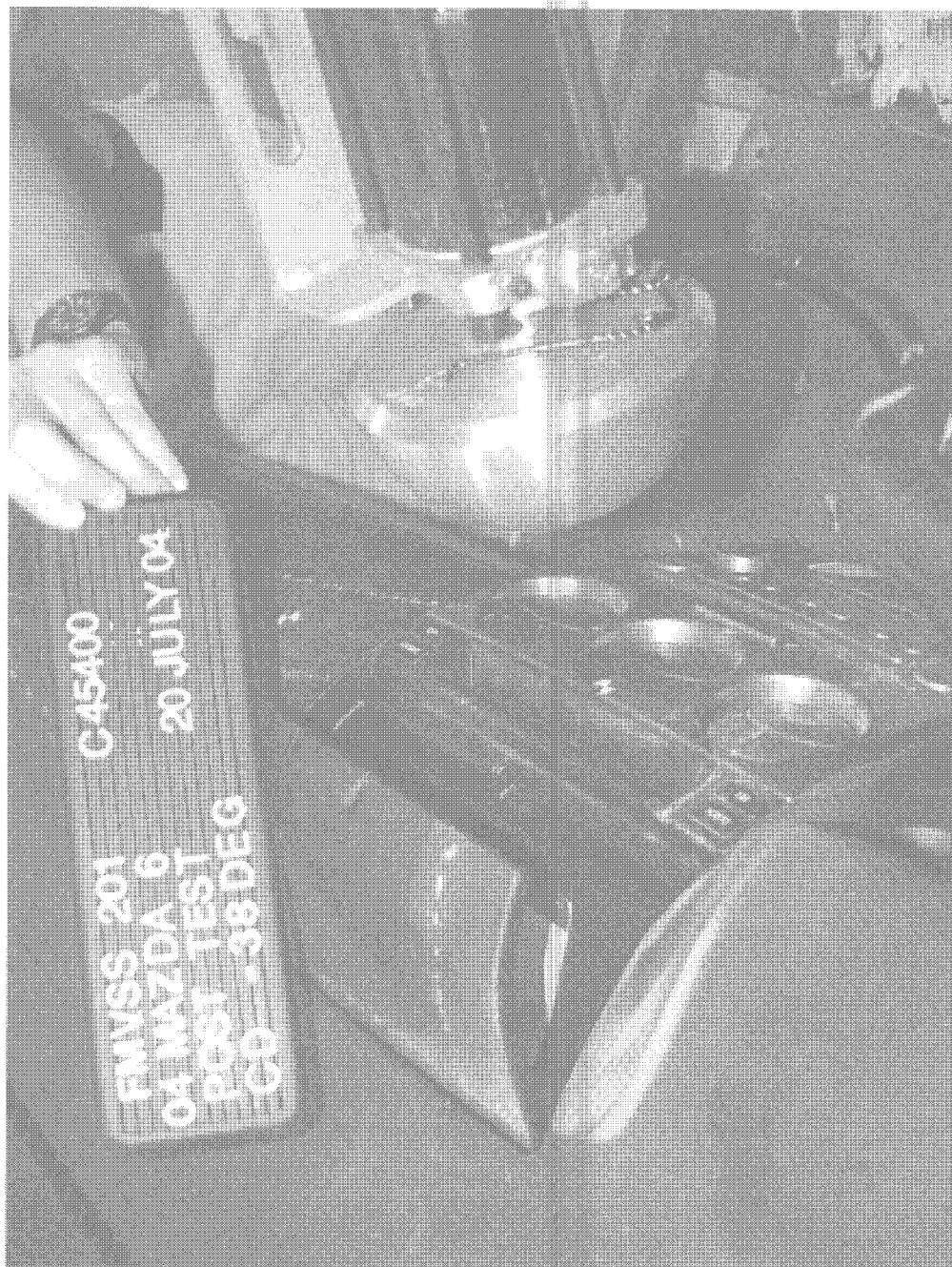


Figure A-19 : INSTRUMENT PANEL IMPACT POST-TEST



Figure A-20 : HEAD RESTRAINT



Figure A-21 : HEAD RESTRAINT IMPACT AREA PRE-TEST



Figure A-22 : HEAD RESTRAINT IMPACT AREA POST-TEST

APPENDIX B

INTERIOR COMPARTMENT DOOR CALCULATIONS

FMVSS No. 201
Latch Component Analysis Information

Latch component inertial analysis information for each interior compartment door assembly located in an instrument panel, console assembly, seat back, or side panel adjacent to a designated seating position in accordance with the procedure described in section 5 of SAE Recommended Practice J839b, "Passenger Car Side Door Latch Systems."

Such data shall include:

1. Geometric details of the latch/lock configuration.

Response: Components subject to this requirement are as follows:

1. Glove-box
2. Coin-box
3. Console lid

2. Mass data for each element in the linkage.

Response: Mass for each element used in calculation are as follows:

1. Glove-box latch knob: 0.015 kg
2. Coin-box latch button: 0.005 kg
3. Console lid latch knob: 0.010 kg

3. Spring rates for each spring element in the configuration.

Response: Manipulating forces to be applied to latch knob/button in order to release latch systems are specified in design drawing. These forces are used in calculation instead of spring forces. These manipulating forces to each knob/button are as follows:

1. Glove-box latch knob: 8.0 ± 4.0 N
2. Coin-box latch button: 3.0 ± 2.0 N
3. Console lid latch knob: 6.4 ± 3.0 N

4. Any additional details unique to the design yet necessary for the calculations.

Response: As described in the above response no. 3 Mazda used manipulating forces specified in design drawing. In calculation we have compared inertia moments or forces at latch knob/button to the minimum value of manipulating moments/forces. Calculations are shown in the attachment 1.

FMVSS 201 TEST

Model	2004MY Mazda6
Vehicle Type	Sedan/ Hatchback
Test	Component test

Date	2003/12/3
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Representative Component	No.	
	Name	
a) Glove-box ASSY	GK2A 55001	PANEL COMPT-INST
b) Coin-box ASSY	GK2A 64030	
c) Rear console ASSY	GK2A 64180	
	GK2A 64420	

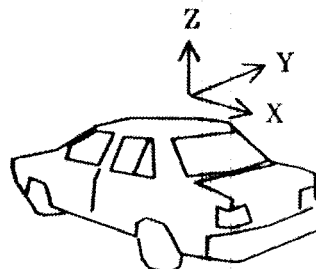
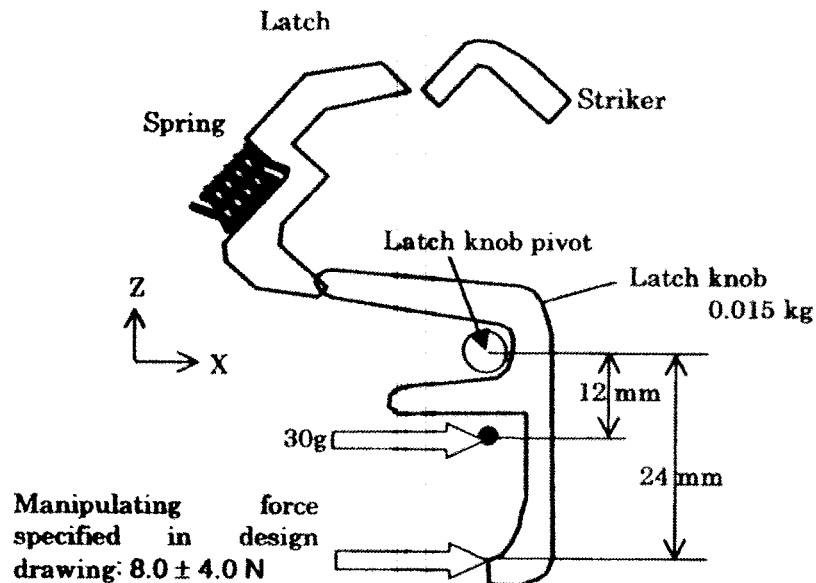
a) Glove-box ASSY (GK2A 64030)	Judgment	Pass
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Latch system for glove-box is composed of a rotating latch knob, a sliding latch and a coil spring as shown in the figure. We have assumed that mass of latch itself is negligible. In considering the mass of latch knob, 30g acceleration to X direction is calculated as the worst case.

$$(1) [\text{Moment by latch knob inertia}] = [\text{Mass of latch knob: } 0.015 \text{ kg}] \times 30g \times [\text{Length: } 12\text{mm}] = 5.4 \text{ Nmm}$$

$$(2) [\text{Minimum moment for latch release}] = [\text{Minimum value of manipulating force: } 4.0 \text{ N } (= 8.0 - 4.0)] \times [\text{Length: } 24 \text{ mm}] = 96 \text{ Nmm}$$

(1) [Moment by latch knob inertia] < (2) [Minimum moment for latch release]
Therefore latch would remain closed.



b) Coin-box ASSY (GK2A 64180)

Judgment

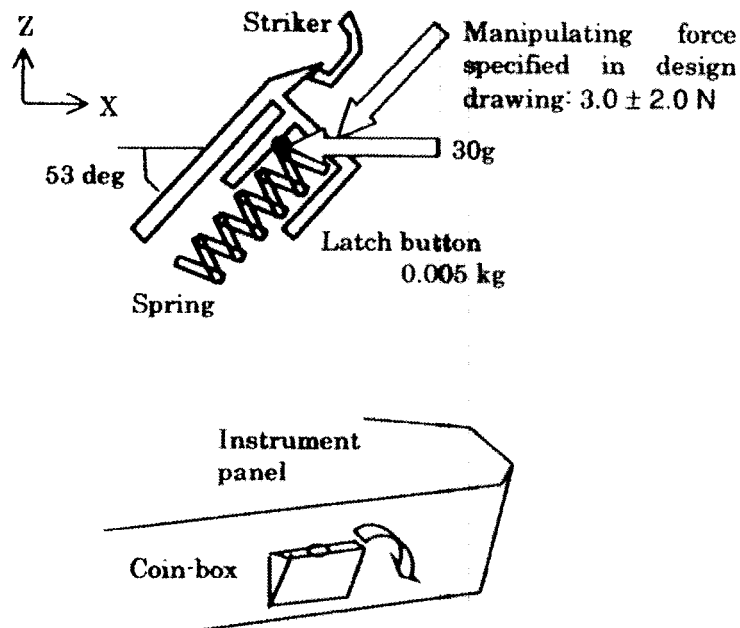
Pass

Coin-box is a small door attached to the instrument panel. When sliding button is pushed, the coin-box lid can rotate to open. Latch system for coin-box is composed of a sliding latch button that is integrated with latch pawl and a coil spring as shown in the figure. In considering the mass of latch button, 30g acceleration to - X direction is calculated as the worst case.

$$(1) [\text{Force by latch button inertia}] = [\text{Mass of latch button: } 0.005 \text{ kg}] \times 30g \times \cos 53^\circ = 0.88 \text{ Nmm}$$

$$(2) [\text{Minimum force for latch release}] = [\text{Minimum value of manipulating force: } 1.0 \text{ N } (= 3.0 - 2.0)] = 96 \text{ Nmm}$$

(1) [Force by latch button inertia] < (2) [Minimum force for latch release]
Therefore latch would remain closed.



c)	Rear-console ASSY (GK2A 64420)	Judgment	Pass
Latch system for rear console is composed of an elastic latch knob only which is attach to the compartment door lid as shown in the figure. We have calculated 10g in Z direction and 30g in -X direction as worst cases.			
(1) [Moment by latch knob inertia (10g in Z direction)] = [Mass of latch knob: 0.01 kg] \times 10g \times [Length: 11mm] = 1.1 Nmm			
(2) [Moment by latch knob inertia (30g in -X direction)] = [Mass of latch knob: 0.01 kg] \times 30g \times [Length: 19mm] = 5.7 Nmm			
(3) [Minimum moment for latch release] = [Minimum value of manipulating force: 3.4 N (= 6.4 - 3.0)] \times [Length: 32 mm] = 109 Nmm			
(1) [Moment by latch knob inertia (10g in Z direction)] < (3) [Minimum moment for latch release]			
(2) [Moment by latch knob inertia (30g in -X direction)] < (3) [Minimum moment for latch release]			
Therefore latch would remain closed.			
<p>Diagram illustrating the latch system for the rear console. The diagram shows the latch knob (0.01 kg) attached to the door lid. The distance from the latch knob pivot to the point of application of the 10g force is 11 mm. The distance from the pivot to the point of application of the 30g force is 19 mm. The total length from the pivot to the end of the knob is 32 mm. The diagram also shows the striker and the manipulating force specified in the design drawing: 6.4 ± 3.0 N. A coordinate system with Z (vertical) and X (horizontal) axes is shown.</p>			

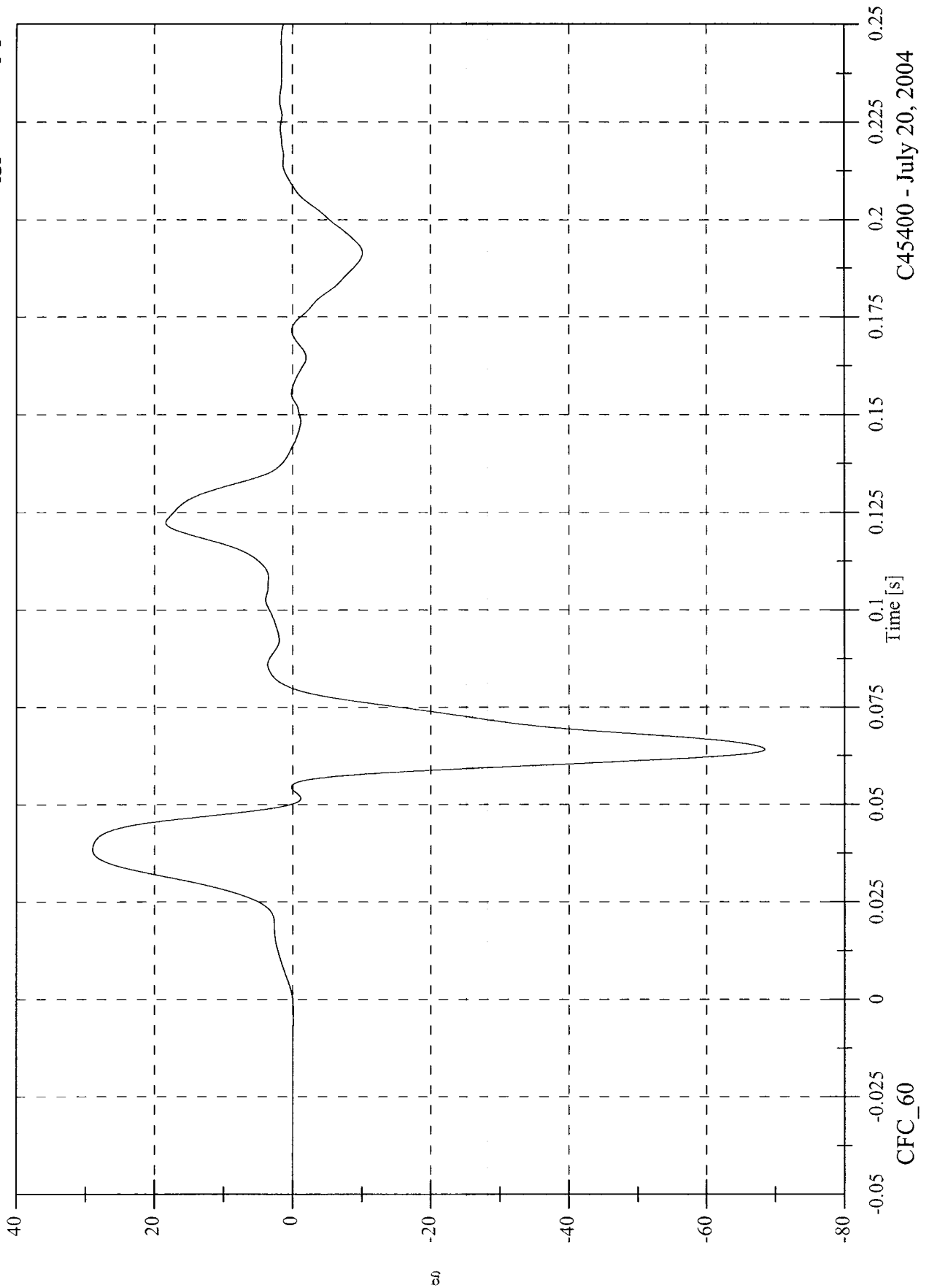
APPENDIX C

DATA PLOTS

FMVSS 201 Linear Impact - 2004 Mazda 6 - Right Side Airbag -51 Degrees
Headform Front Ax

Max: 29.0 [g] at 0.039 [s]

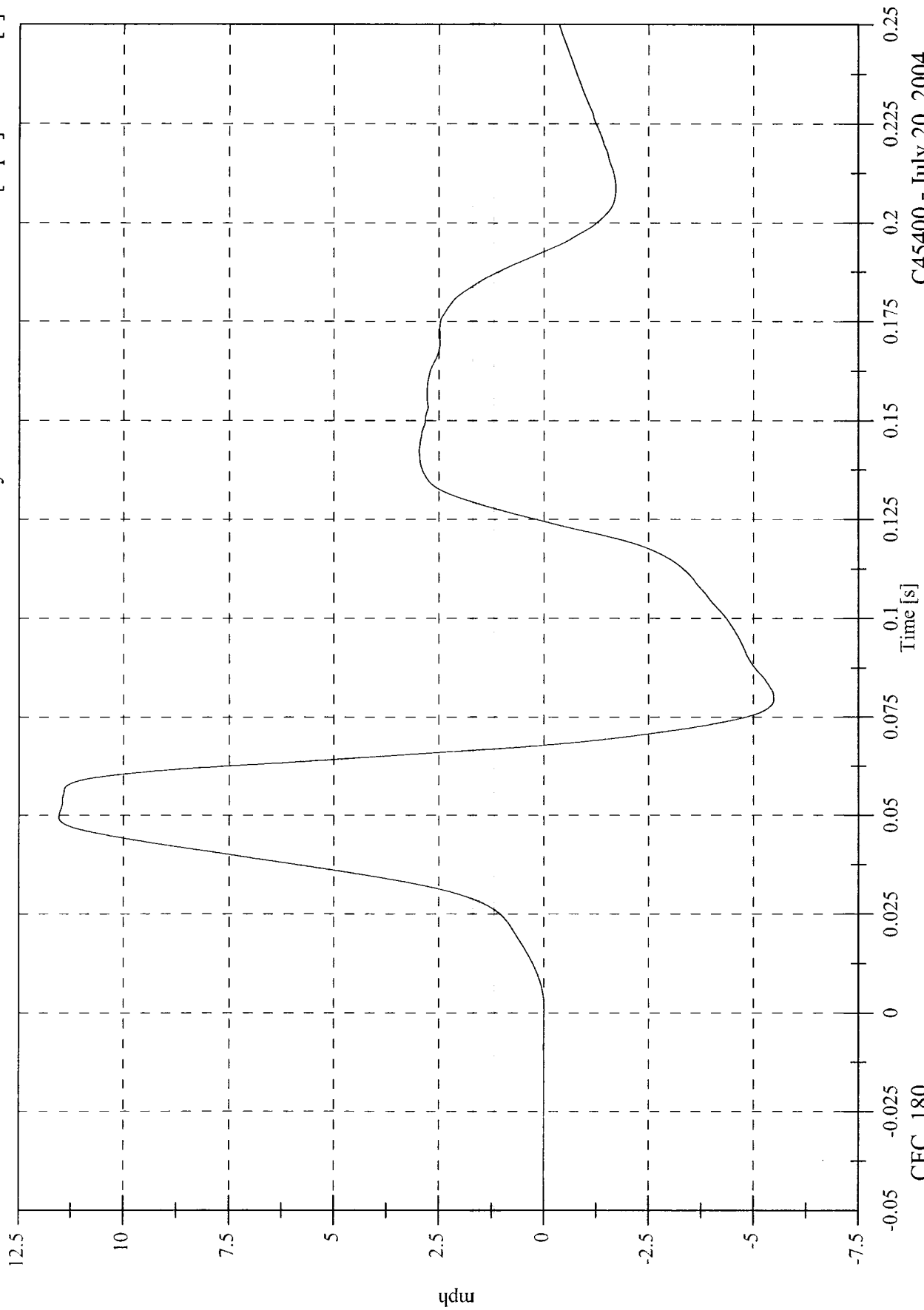
Min: -68.5 [g] at 0.064 [s]



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FMVSS 201 Linear Impact - 2004 Mazda 6 - Right Side Airbag -51 Degrees
 Headform Front Ax Velocity

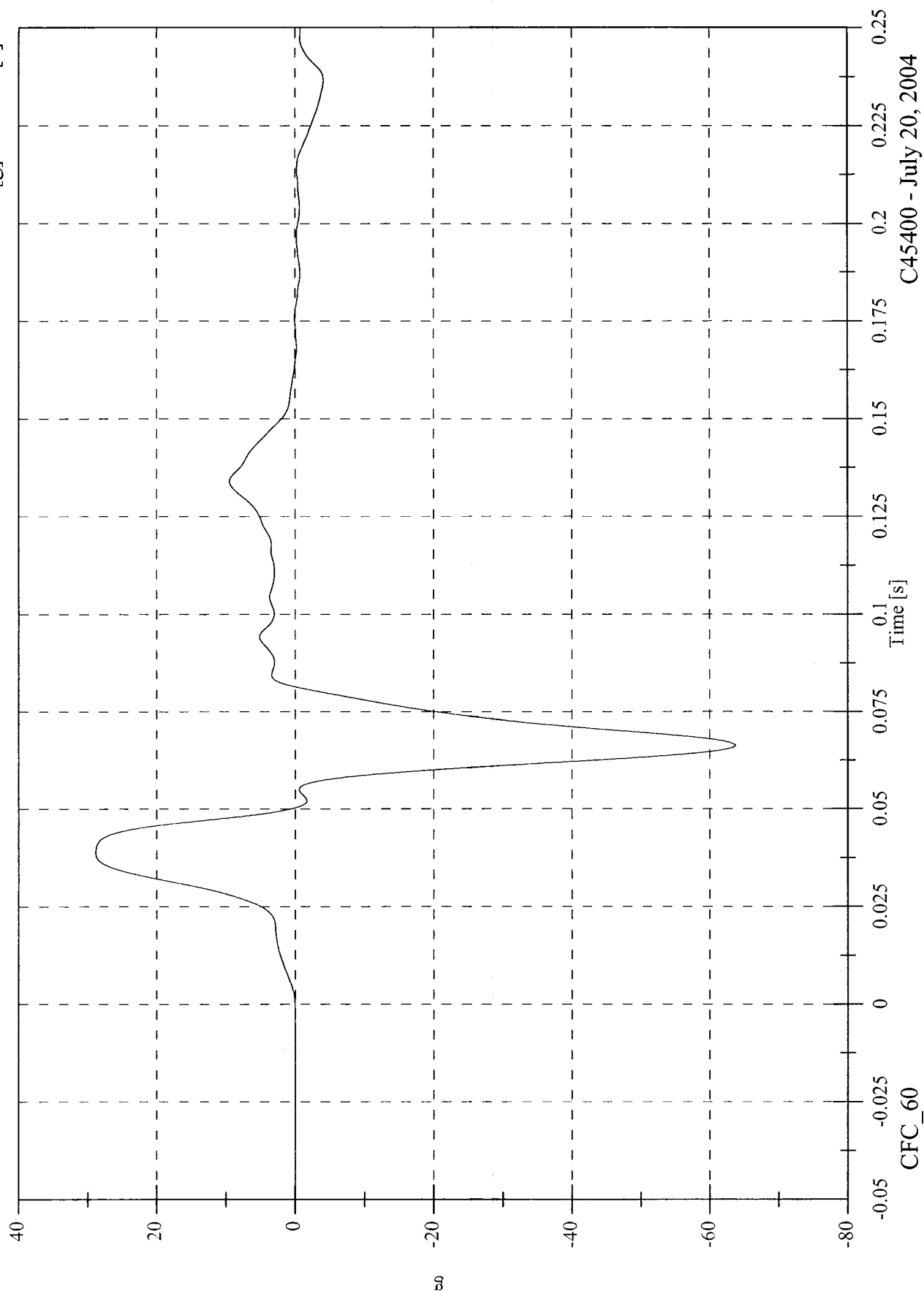
Max: 11.5 [mph] at 0.050 [s]
 Min: -5.5 [mph] at 0.079 [s]



C45400 - July 20, 2004

FMVSS 201 Linear Impact - 2004 Mazda 6 - Left Side Airbag -45 Degrees
Headform Front Ax

Max: 28.9 [g] at 0.039 [s]
Min: -63.7 [g] at 0.066 [s]

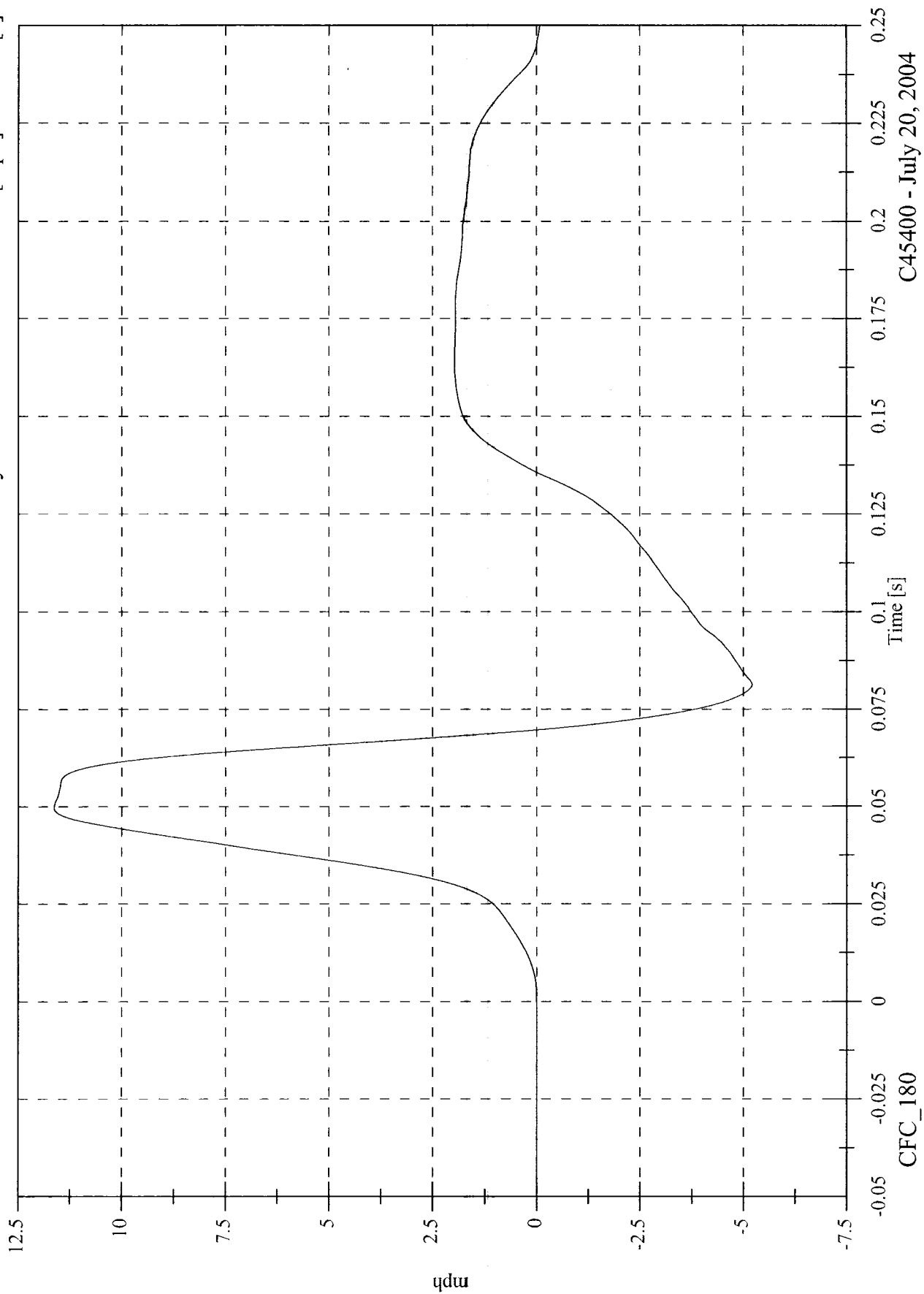


C45400 - July 20, 2004

FMVSS 201 Linear Impact - 2004 Mazda 6 - Left Side Airbag -45 Degrees
Headform Front Ax Velocity

Max: 11.6 [mph] at 0.050 [s]

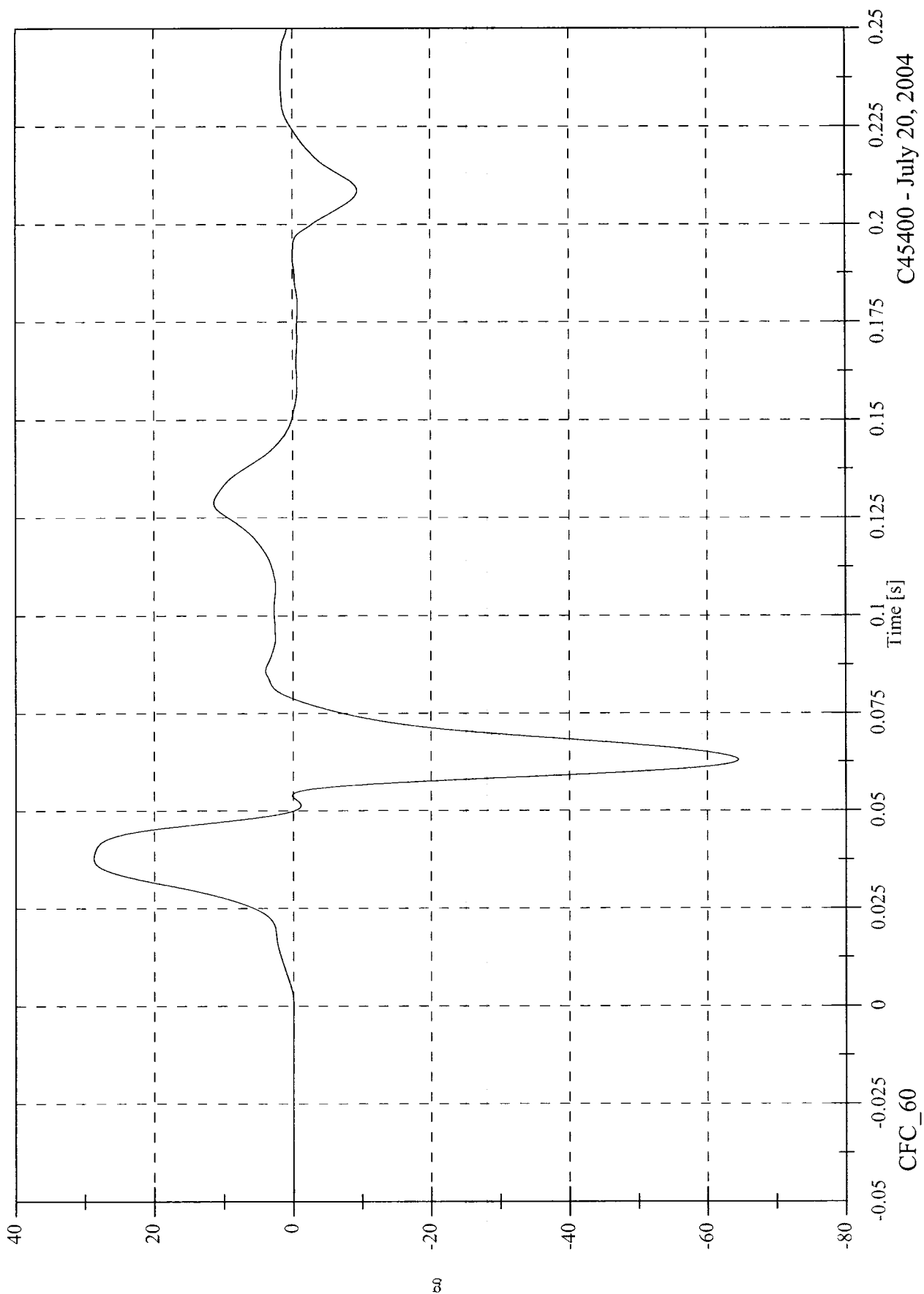
Min: -5.2 [mph] at 0.081 [s]



C45400 - July 20, 2004

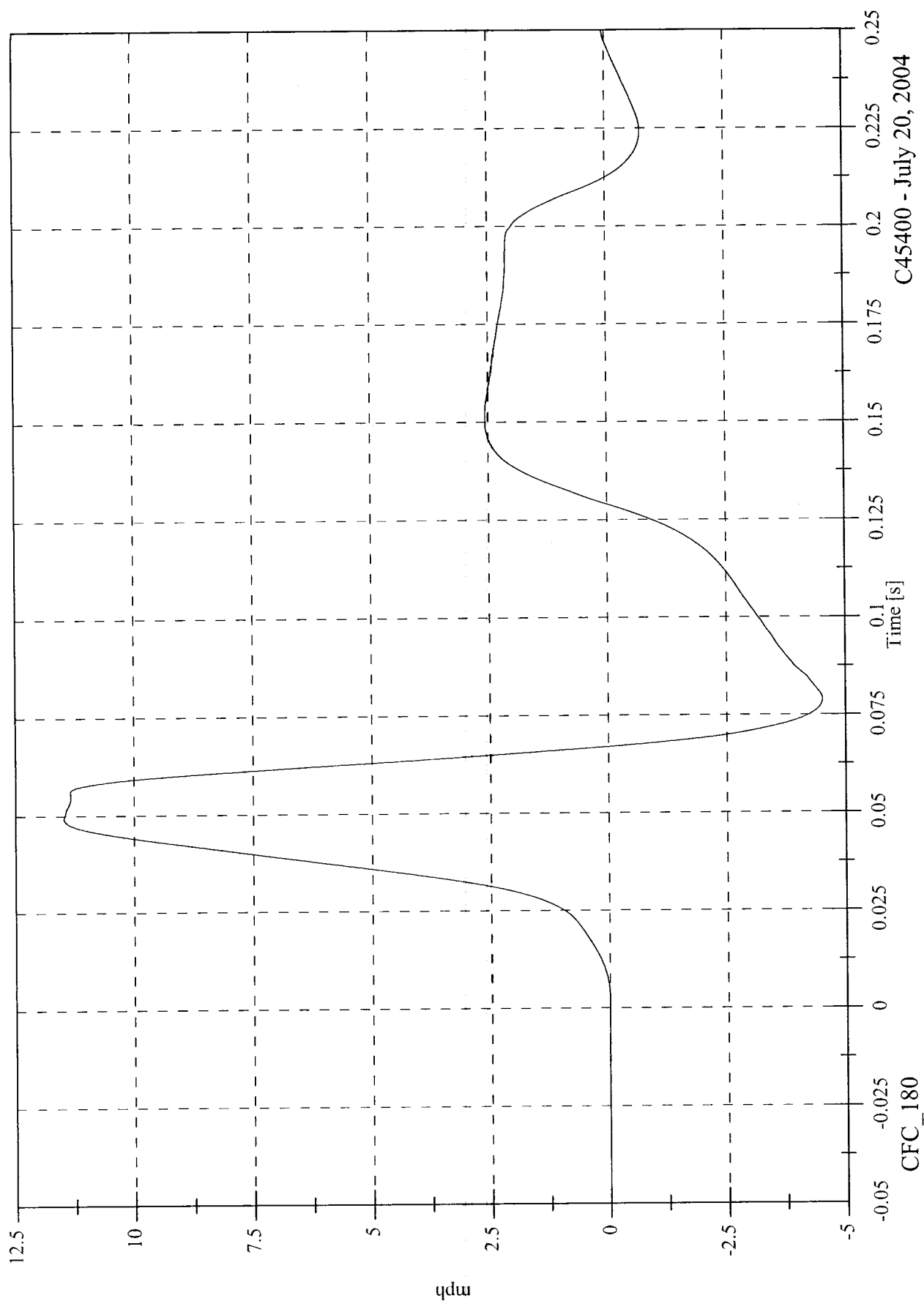
FMVSS 201 Linear Impact - 2004 Mazda 6 - Center Inst. Panel -38 Degs
Headform Front Ax

Max: 28.7 [g] at 0.038 [s]
Min: -64.5 [g] at 0.063 [s]



Max: 11.5 [mph] at 0.049 [s]
Min: -4.5 [mph] at 0.079 [s]

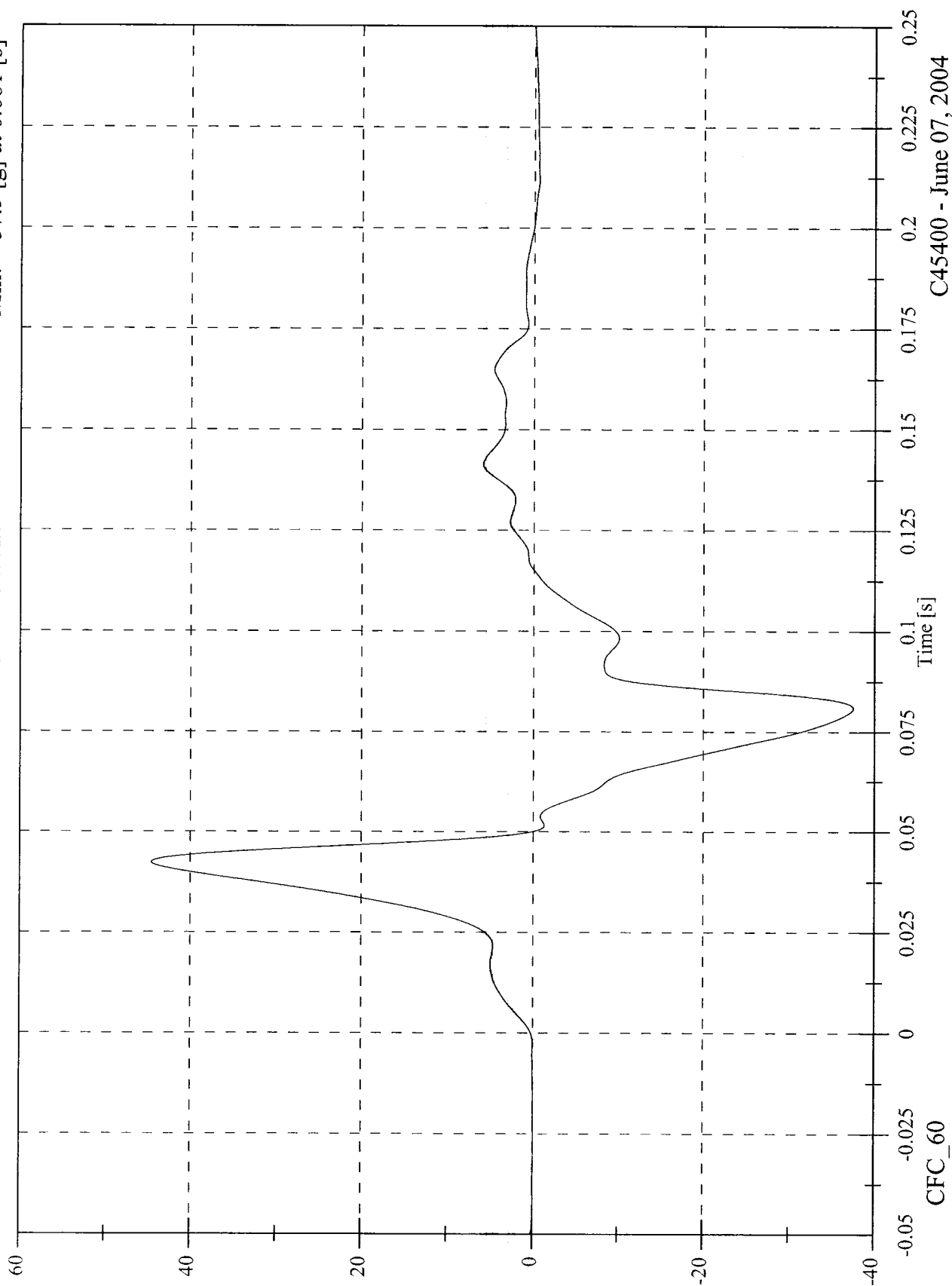
FMVSS 201 Linear Impact - 2004 Mazda 6 - Center Inst. Panel -38 Degs
Headform Front Ax Velocity



C45400 - July 20, 2004

FMVSS 201 Linear Impact - 2004 Mazda 6 - Seat Back -40.0 Degrees
Headform Front Ax

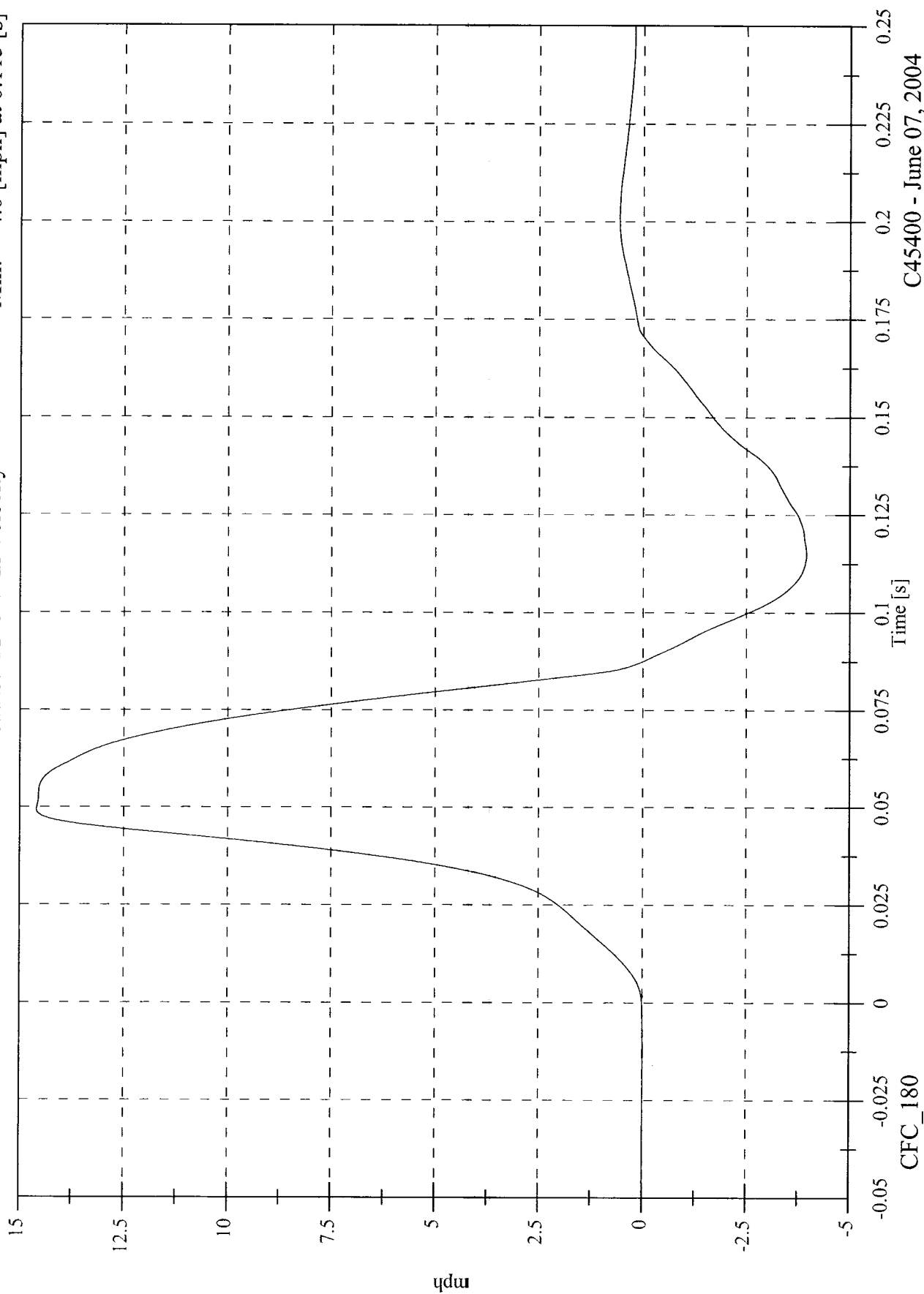
Max: 44.6 [g] at 0.042 [s]
Min: -37.5 [g] at 0.081 [s]



C45400 - June 07, 2004

FMVSS 201 Linear Impact - 2004 Mazda 6 - Seat Back -40.0 Degrees
Headform Front Ax Velocity

Max: 14.6 [mph] at 0.049 [s]
Min: -4.0 [mph] at 0.115 [s]



C45400 - June 07, 2004